ARI NEWSLETTER

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Generation X: Motivations, Morals and Values

Generation X members, born between 1961 and 1981, are now fully represented in the Armed Services and are advancing through the ranks. While most of these soldiers are still junior enlisted, some have moved into positions of authority (Figure 1). The Army has become an organization led by the Baby Boom generation, "Boomers," born between 1943 and 1960, and staffed by Generation Xers.

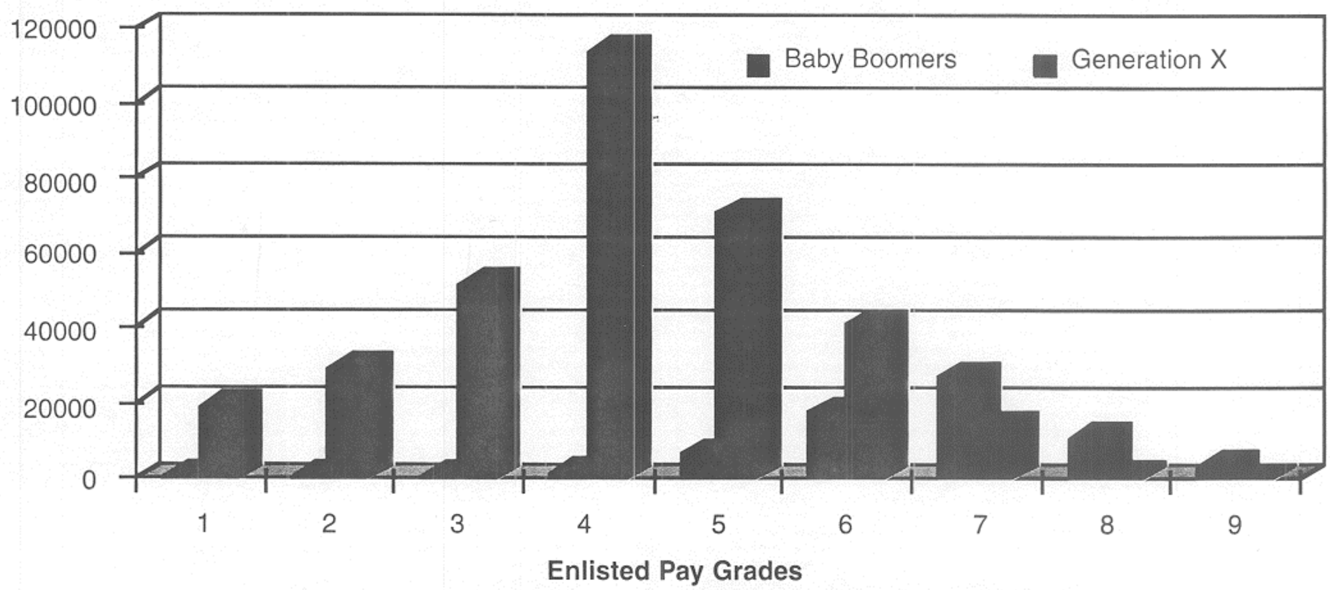

Figure 1. Comparison of Generation X and Baby Boomers by Enlisted Pay Grades

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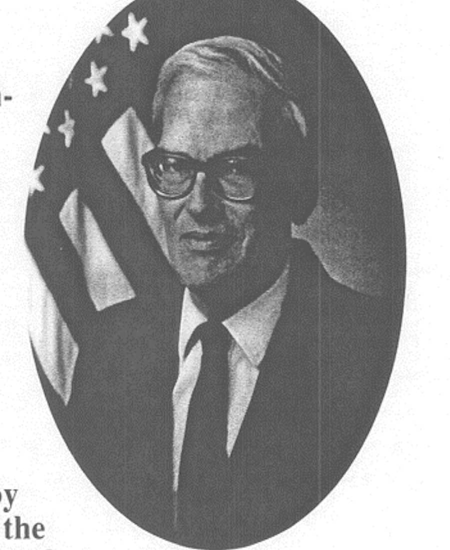


Motivation and attitude are among the many factors Army managers deal with in the personnel area. These factors vary between individuals, but trends can be described for society in general. Our lead article in this Newsletter deals with what has come to be known as Generation X — individuals now between 16 and 36 years old — and how their traits relate to Army problems such as attrition and delinquency. On the plus side, the motivational characteristics of this generation suggest new leadership strategies as well as ways to take full advantage of their particular talents and interests, such as their familiarity with computer and information technology.

Another type of broad perspective on research issues is shown by the High Performing Soldiers Technology Demonstration, described in the second article. This event featured technology to assist in the selection and assignment of enlisted soldiers, and was a major milestone in a series of research programs which began in 1982 with "Project A" and continued with "Career Force". As a result of this research, future changes in how soldiers are selected and assigned can be made based on a wide range of information on how different types of test contribute to the prediction of future performance, and on which combination of tests provides the best prediction for a specified purpose.

The focus of the other articles in this issue is on specific research problems which have been successfully dealt with through application of behavioral science principles. In one case, we confirmed that the Conduct-of-Fire Trainer (COFT) for training tank gunnery is effective in predicting live-fire success, and developed a tool for predicting live-fire Table VIII gunnery performance on the range using COFT test scores. This tool is important to the Army National Guard, in particular, for assessing readiness for live-fire gunnery before going into the annual Table VIII exercise. This effort previews future training strategies where skills are acquired and polished in simulators or synthetic environments and then demonstrated in live exercises.

Another specific research issue connected with simulation involves training in Virtual Environments (VE). While VE has tremendous potential for training for the high-technology battlefield of the future, an unwanted side effect has been symptoms resembling those of motion sickness. Our research on this issue so far has yielded a number of recommendations for simulator and task characteristics that can help mitigate these effects. The area of simulation also raises questions about collective training — training teams of soldiers in synthetic training environments such as Distributed Interactive Simulation (DIS), as exemplified by SIMNET and the Close Combat Tactical Trainer (CCTT). This new type of training requires specialized research in instructional methods and strategies; the article in this issue deals with one strategy in particular, that of encouraging the use of shared mental models.

On the leadership side, we describe a new self-development tool called AZIMUTH. This provides what is known as a 360-degree assessment — the ability to analyze one's own attitudes and behaviors, and to get feedback from others. Finally, on the manpower modeling side, we offer a brief summary of the OPICC model, which is currently available for use by manpower analysts to predict the long-term effects of manpower policies and resource decisions on the officer force.

The articles in this issue represent a wide range of issues of concern to Army leaders. And, each one is only the "tip of the iceberg" in terms of the breadth of the research program and the magnitude of effort involved. I invite you to follow up and seek more information, starting with our web site at http://www.ari.fed.us.

Edgar M. Johnson

Table 1 (below) summarizes differences between Generation X and the Boomers drawn from Blazar & Fuentes (1997). These differences, such as Generation Xers' preference for immediate gratification, and their tendency to question authority, are important because they may relate to problems leaders are encountering with junior soldiers, such as attrition and delinquency. The differences also suggest leadership techniques. For example, demonstrated competence may be more important than rank when leading Generations Xers.

Table 1. Comparison of Generation X and Baby Boomers

Dimension	Generation X	Boomers
Outlook on Life	Self Centered	Work Oriented
Authority	Performance Oriented	Rank Oriented
Motivations~Gratification	Current Life Quality	Possessions~Long Term
Feedback Required	Immediately	Delayed
High Technology	Interested	Uncomfortable
Institutions	Distrustful	Loyal
Independence	Up (Latch Key Kids)	Down (Stay Home Moms)
Cynicism	Up (Watergate/Crime)	Down (Civil Rights/Prosperity)
Religion	Down (31% attend)	Up (40% attend)

Recruiting, training and leading Generation X is a challenge to the military because the motivations, morals and general values of these individuals often differ from Boomers. By recognizing differences between Generation X and earlier cohorts, and linking these differences to variables such as family structure and rearing practices, it may be possible to lead today's and tomorrow's youth better.

The American Family Structure

Many of the largest societal trends influencing Generation X have been linked to the dramatic evolution of the American family structure over the last 30 years. During this time, the divorce rate climbed from 11 percent for the parents of Boomers to 40 percent for the parents of Generation Xers (Holtz, 1995). In addition, births to unwed mothers soared from 5 percent in 1960 to 18 percent in 1980, to 30 percent in 1992 (Department of Health & Human Services, 1996)[1]. As a consequence, 50 percent of Generation X were raised for some time in single parent homes (Holtz, 1995).

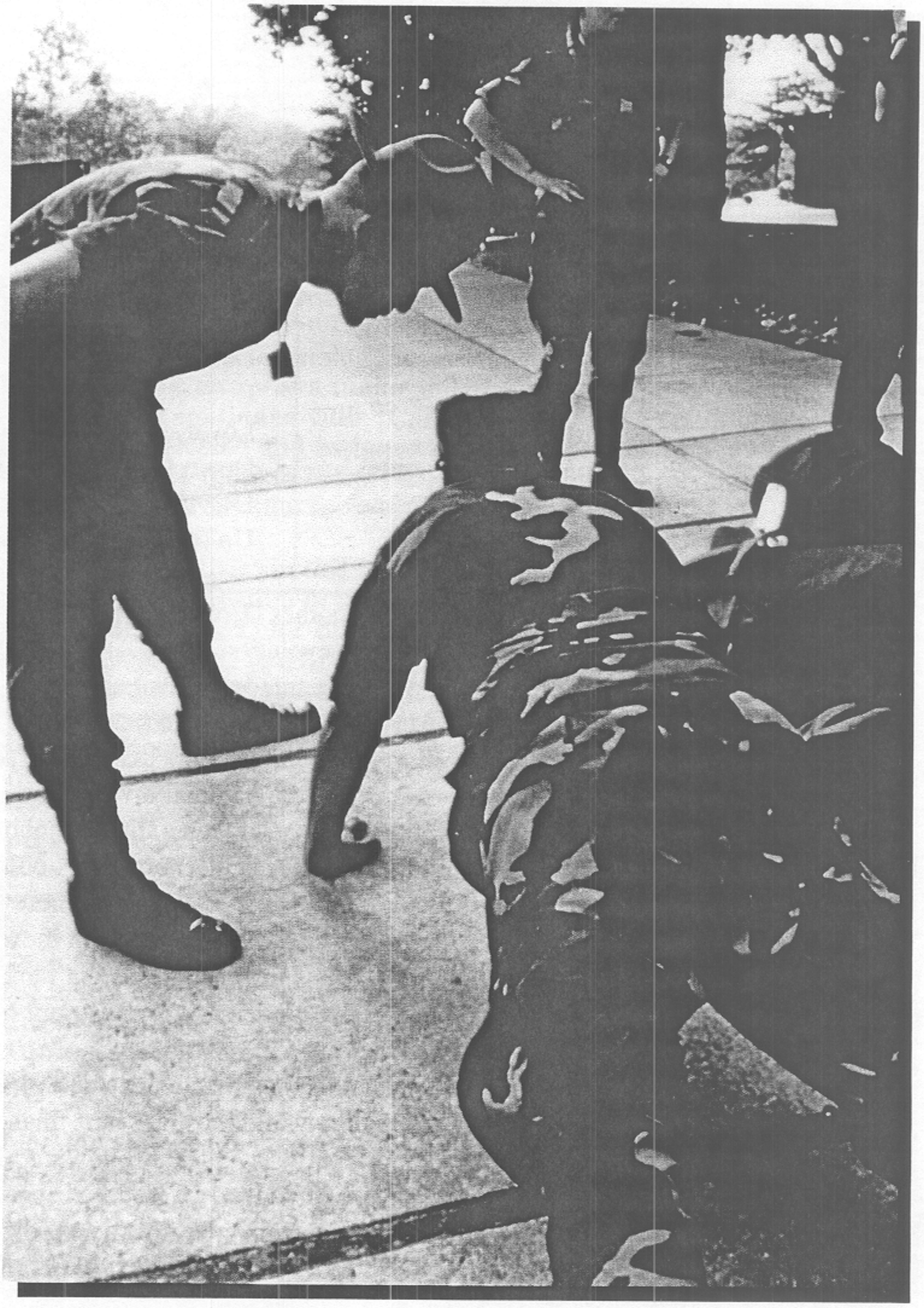
The evolution of the American family represents long term trends. Thus tail-end Boomers, born between 1955 and 1960, tend to be more similar to early Generation Xers than to early Boomers. Likewise, the parental divorce and unwed mother rates of tail-end Generation X cohorts tend to be higher than early Generation X cohorts. Future generations are likely to be even more impacted by deteriorating family structure than those of Generation X. Individuals from single-parent families are at substantially higher risk for a variety of negative social consequences.

As a general statement, few children benefit from a divorce while most are hurt financially and injured emotionally: five years following a divorce, while 80 percent of parents viewed their post- divorce life as better, more than half of the children reported little or no improvement (Holtz, 1995). One of the basic problems associated with divorce is that the time single parents can devote to their children is very limited compared to that of a traditional intact family.

[1] The DHHS data (1996) indicate that 30 percent of all children did not live in two parent homes in 1994, while only 13 percent did not in 1960.

It is estimated that the average Boomer was supervised 30 hours per week, while the average Generation Xer was supervised for 17 hours per week (Holtz, 1995).

Other divorce-related problems associated with rearing Generation Xers are: their lack of discipline associated with minimal supervision, limited financial resources, frequent changes of schools and neighborhoods, use of television as a baby sitting device, and inconsistent parenting styles as disagreements flare between Mom, Dad, Grandparents and others who share parenting duties.



In terms of the development of Generation X morals and values, the statistics tell a consistent story. Individuals from non-intact families (i.e., lacking two biological parents) are disproportionately represented in: prison incarcerations, mental institutionalizations, teen pregnancies, suicides, drug and alcohol abuse, run-away rates, use of drugs to control hyperactivity, child molestation, throw-away children (i.e., neither parent accepting child custody), school behavior problems and drop out rates (Holtz, 1995). From a military perspective, it is not surprising that Generation Xers are stereotyped as less work-oriented, more problem-prone, and less respectful of authority/rank than earlier generations; these characteristics are evident in schools and continue into adulthood.

To the best of our knowledge, trends in the family structure of recruits have not been carefully monitored, and most military surveys have not obtained descriptions of a soldier's family background. While divorce and family issues need to be addressed to identify potential solutions, this must be done in a sensitive manner to avoid offending individuals with the implication that all non-traditional families are problematic.

The University of Michigan has collected longitudinal data to monitor trends affecting American high school students since 1976. Their surveys contain items addressing interest in pursuing the military as a career and quantifying the number of adults liv-

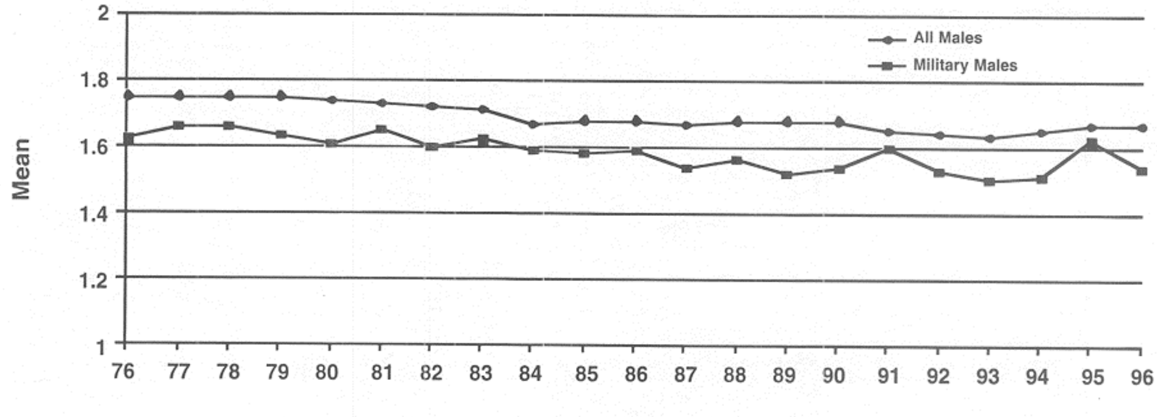


Figure 2. Number of Adults in the Household, All Males vs Military Bound Males

ing with high school seniors.[2] The survey data show that in 1976, approximately 75 percent of high school seniors lived with two adults (i.e., "parents"), and by 1996 approximately 65 percent of the students lived with two parents. The mean number of parents of military-bound male youth paralleled this decrease and was uniformly lower by approximately 0.1 parents (Figure 2). By 1995, approximately 45 percent of military-bound male youth were coming from single parent homes with many of the remaining 55 percent coming from blended homes.

A similar but more extreme tendency is associated with military-bound female youth. Over the 20-year period, military bound female youth had an average of 0.2 fewer parents than high school females (Figure 3). In 1976, approximately 45 percent of female recruits came from single parent homes, and by 1996 approximately 55 percent of female recruits were from single parent homes. Included in the remaining 45 percent of female recruits are individuals from blended homes.

The University of Michigan data show that the military is more likely to attract individuals from broken homes than from intact homes. This tendency is disturbing because while higher-achieving and less-delinquent youth constitute the military's prime recruiting market, these characteristics are underrepresented among individuals from non-intact families. It seems probable that some of the problems the military is now experiencing with its soldiers, such as attrition and insubordination, reflect the family struc-

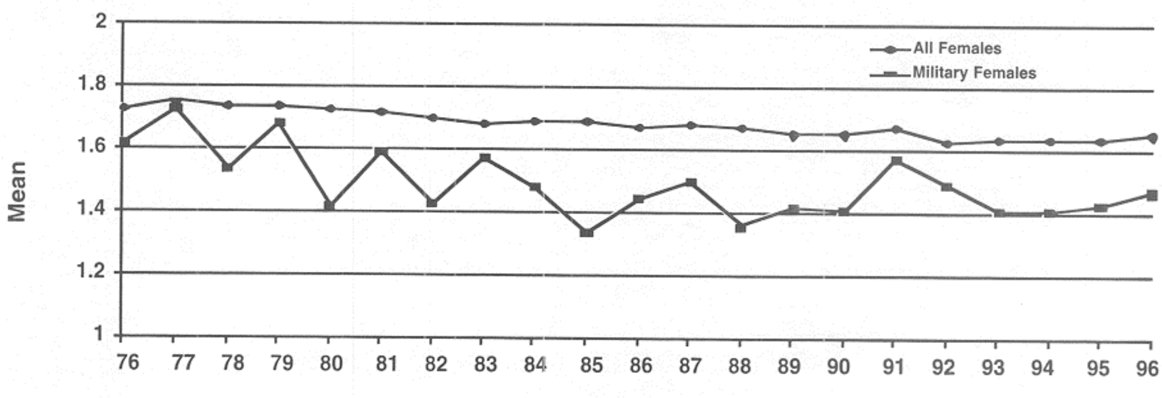


Figure 3. Number of Adults in the Household, All Females vs. Military Bound Females

[2] The University of Michigan data do not distinguish between intact families with two biological parents and blended families with a step-parent. Therefore these statistics understate the incidence of high school seniors from broken homes.

ture in which these individuals were raised.

Church, Schools and Society

Decline in church attendance is an example of a general societal change that has affected many Americans. From 1976 to 1993 weekly church attendance of high school seniors dropped from an average of 41 percent to 31 percent (U.S. DHHS, 1996). It seems reasonable to expect that a 10 percentage point decrease in church attendance may be related to changes in youth morals and values.

Although we are reminded by the mass media that American students are not the best in the world, school performance data indicate that students have not changed much. Since 1986, Scholastic Aptitude est (SAT) Math scores have increased slightly, while SAT Verbal scores have declined slightly, and the National Assessment of Educational Progress data indicate a slight improvement in the domains of reading, writing, mathematics and science (U.S. DHHS, 1996). Likewise, RAND Corporation has projected a slight increase in the AFQT scores of high school students (Kilburn, Hanser & Klerman, 1996). In addition, school curricula have broadened and now include topics that did not previously exist, e.g., computer science and molecular biology. It does not seem likely that problems associated with today's youth reflect deteriorating schools.

Some observers have pointed out that society's attitudes toward children have changed. The differences are reflected in lower educational budgets, higher child poverty rates and deteriorating child medical care (Howe & Strauss, 1993; Holtz, 1995). The physical fitness of youth has deteriorated: the proportion of overweight teenagers increased from 15 percent in 1978 to 21 percent in 1989 (U.S. DHHS, 1996).

On the positive side, home computers and the Internet have given youth access to knowledge and skills that were unavailable to previous generations. As a consequence, Generation Xers are sometimes referred to as technoliterate and as information managers (Filipczak, 1994).

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References

Blazar, E., & Fuentes, G. (1997, May 5). Generation X. Navy Times, 46(31), 12-17.

Filipczak, B. (1994, April). It's just a job. Training, 31(4), 21-27.

Holtz, Geoffrey T. (1995). Welcome to the Jungle. New York: St. Martin Press.

Howe, N., & Strauss, B. (1993). 13th Gen Abort, Retry, Ignore, Fail? New York: Random House, Inc.

Kilburn, M. R., Hanser, L. M., Klerman, J. A. (1996). Test Score Trends and Military Recruiting: Estimates from the NELS. Santa Monica, CA: Rand Corporation.

U.S. Department of Health and Human Services. (1996). Trends in the Well-Being of America's Children and Youth: 1996 [on line]. Available: http://aspe.os.U.S. DHHS.gov/hsp/trends/toc.htm.

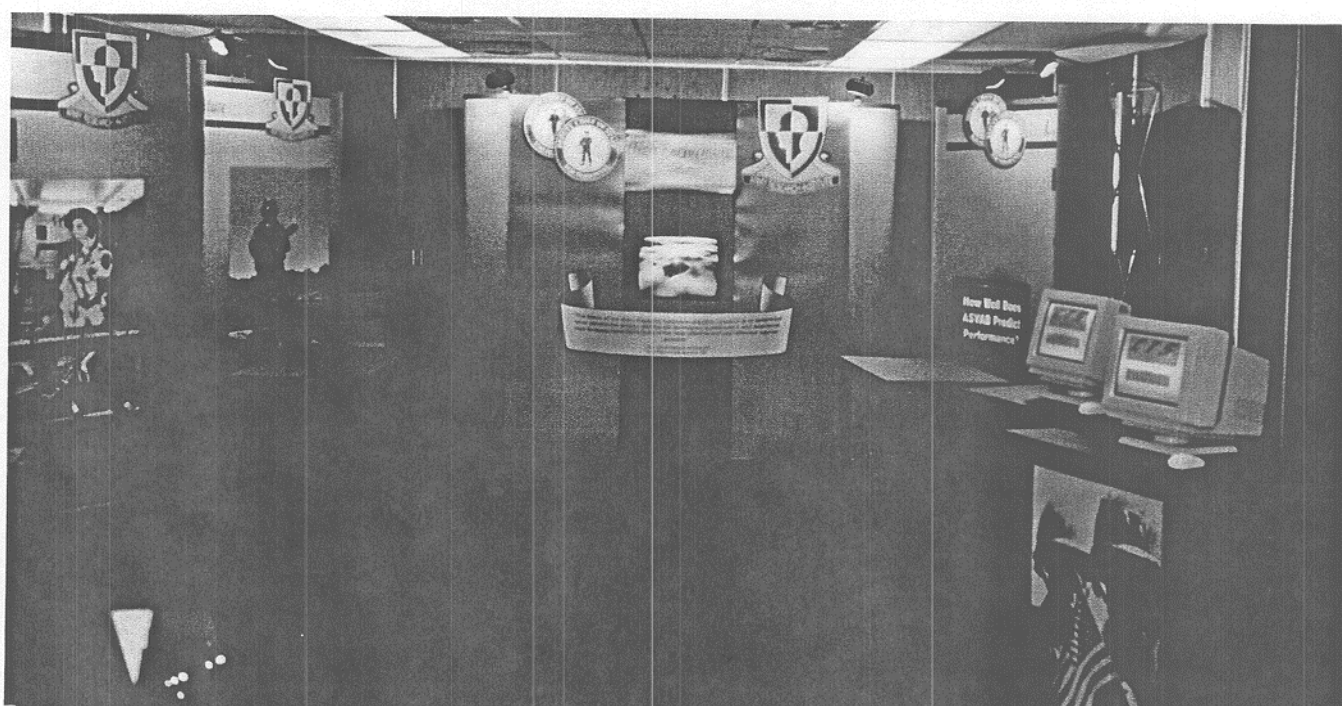
Selecting and Assigning Quality Soldiers -- A Demonstration

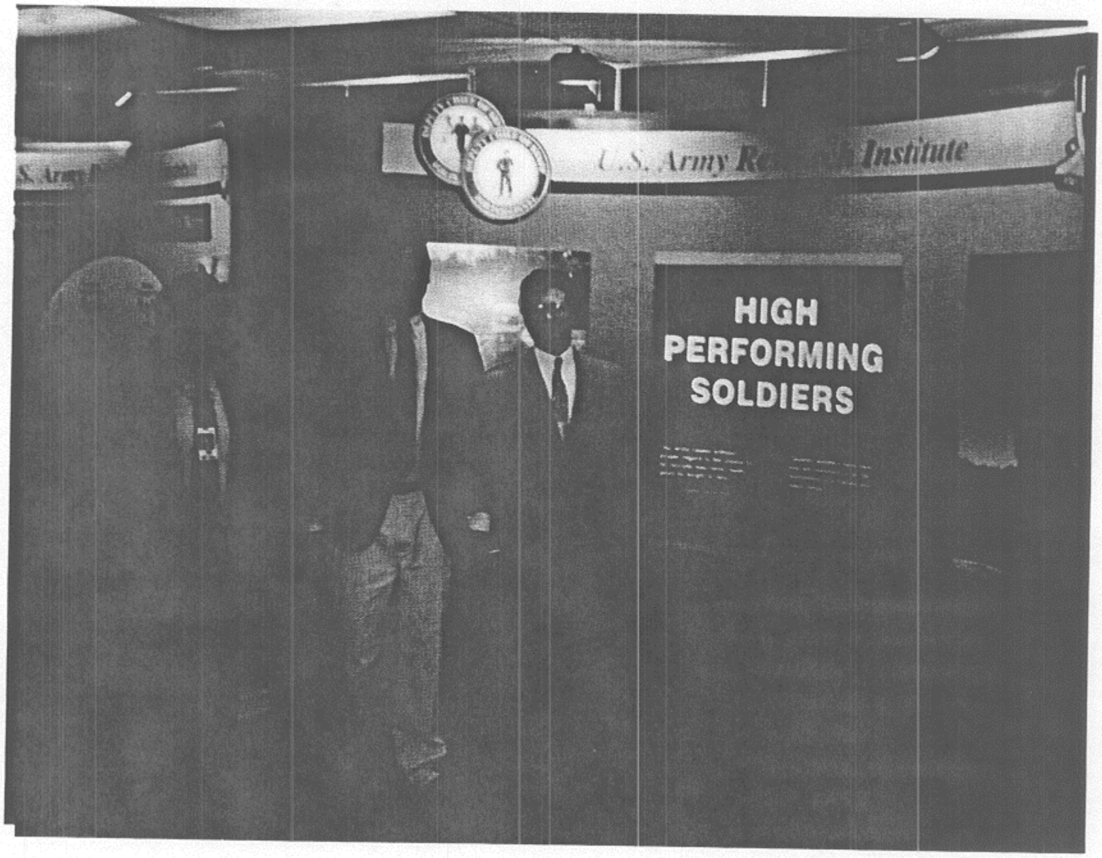
"Quality soldiers have been and will continue to be the foundation of a trained and ready force." This statement, by Chief of Staff General Dennis Reimer (Army, October, 1995, p. 23), expresses the current importance of quality soldiers to Army leadership. The U.S. Army Research Institute (ARI) recognized the importance of soldier quality when it began a program of research in 1982 to improve the Army's selection and assignment system. In a Demonstration conducted at the Pentagon, on 25 October 1996, ARI presented a full package of selection and assignment tools which resulted from this research and which can go far towards enhancing soldier quality.

The one hour Demonstration, consisting of a taped overview, several oral presentations by ARI scientists, two computerized presentations, several exhibits and multiple handouts, was repeated four times over the course of the day. The first session was introduced by the Deputy Chief of Staff for Personnel, Lieutenant General F. E. Vollrath, who forcefully conveyed his belief in the importance of the work presented. Following additional introductory comments by Dr. Michael Rumsey, guests were ushered to separate stations which covered accomplishments in three areas: linking existing selection tests to job performance, developing new tests for selection, and improving the person-job match.

Linking ASVAB to Job Performance

For twenty years, the Armed Services Vocational Aptitude Battery (ASVAB) has been used to determine whether applicants are qualified for Army jobs. What was not known prior to this research on selection and assignment, however, was how well ASVAB performance was related to job performance. This question could not be answered until realistic, scientifically credible measures of job performance could be developed. In the 1980s ARI developed such measures and found that they represented two essentially different categories: one to assess whether the individual *could do* the job effectively and the other to assess whether he or she *would do* so. As Dr. Clinton Walker noted in his presentation of this work during the Demonstration, "Asking whether 'can do' or 'will do' is the key to success on the job is





Drs. Henry Busciglio, Jay Silva, and Dale Palmer were among the participants in ARI's High Performing Soldiers Technology Demonstration.

like asking which of your legs is the key to your running."

Dr. Walker continued, "With this model of performance in hand, the results of our evaluation of ASVAB were strong and clear: Applicants' scores on ASVAB are powerfully related to the can-do, proficiency side of performance." ASVAB was not as closely linked to "the essential motivational side of job performance," so here the potential gain from new selection tests is quite high.

Developing New Tests for Selection

Developments in improved prediction of job performance were also presented at the Demonstration. Dr. Leonard White spoke of some measures which had been developed with respect to the "will do" side of performance. These measures tapped into dependability, work ethic and adjustment. Not only did they add to what the ASVAB could tell us about individual motivation, but they provided excellent tools for predicting attrition. A problem which has inhibited use of such measures thus far is the concern that people might "fake" their answers to the questions presented--presenting a more favorable impression of themselves than is realistically warranted. However, a new instrument called the Assessment of Individual Motivation (AIM) has been found to be highly resistant to faking, while still providing good prediction of attrition.

Dr. Henry Busciglio discussed some new measures which were more closely linked with the "can do" side of performance. These included tests of spatial ability, "the ability to process information about the form, direction, and orientation of objects in space," and tests of psychomotor, or hand-eye coordination, ability. Although the ASVAB is already a good predictor of "can do" performance, it is an even better predictor when a new ARI spatial test known as Assembling Objects is included. This test has been so favorably received that it is being administered as part of a new computerized ASVAB form this year. Although it is not yet being used for selection of enlisted soldiers, Dr. Busciglio noted that it is being used in the Special Forces context "as an aid in making decisions about individual trainees." A psychomotor test of one-hand tracking, which has been found to be an excellent predictor of TOW and tank gunnery performance, was also presented at the Demonstration.

Improving the Person-Job Match

Dr. Jay Silva described ARI's work to improve the person-job match. Sometimes, the immediate need to fill particular jobs takes precedence over virtually all other considerations. There are other times, however, when there is a considerable amount of flexibility in terms of who should be assigned to which job. At these times, two types of information become particularly important: 1) how well does each candidate's abilities match the requirements of each job, and 2) for those jobs which are not filled immediately, what are the prospects of getting candidates who can fill these jobs in the future? With these two kinds of information, people can be assigned in a way that not only meets the Army's immediate needs but also adds greatly to its long-term effectiveness.

Dr. Silva described ARI advances in both developing tools to collect such information and developing a system to make the best possible use of it. This system, known as the Enlisted Personnel Allocation System (EPAS), considers a large number of person-to-job matches simultaneously and determines the best combination for overall Army effectiveness. Dr. Silva presented an interactive computer program to demonstrate the principles behind EPAS. This program allows matching of ten people to three jobs, providing hypothetical test scores showing their measured capabilities with respect to each job. After all have been assigned, the program provides feedback showing the extent to which the assignments capitalized on the capabilities of each individual.

The Future

The Demonstration was well attended and, judging by guests' comments, well received. In Dr. Rumsey's concluding remarks, he noted that, despite ARI's accomplishments in the field of selection and assignment, future challenges remain: "We need to determine what characteristics will help our soldiers meet the demands of the 21st century. We need to better determine what attributes are important throughout a soldier's career, not just in the early stages of this career." ARI will be working with the Office of the Deputy Chief of Staff for Personnel and other Army elements in the coming months to develop a plan to meet the critical selection and assignment challenges of the 21st century.

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

Army National Guard Tank Gunnery: Predicting Live-Fire Success

To maximize the payoff from the 39 training days available each year, armor units of the Army National Guard (ARNG) are looking more and more to use devices for the training of tank gunnery. To promote successful device usage, a strategy is needed to help unit trainers identify which devices to use, which training and evaluation exercises to conduct, and which proficiency standards to apply, so as to produce device- as well as live fire-proficient crews.

To date, several such strategies have been developed. Although they differ in many respects, each recommends use of the Conduct-of-Fire Trainer (COFT), a stand-alone, high-fidelity device designed for training tank commander and gunner pairs on proper target engagement procedures under fully operational and degraded mode equipment conditions. In recommending the use of COFT, it is assumed that simulated gunnery performance on it is representative, and therefore predictive, of live-fire gunnery performance on the range. Until now, this predictive relation has received only limited empirical support. The present research identifies this relation and, from it, develops a simple tool for predicting live-fire-gunnery performance.

What We Did

To assess this relation, 58 tank crews (i.e., commander, gunner, loader, driver) from two battalions of a Western state ARNG armor brigade underwent an hour of COFT testing a day before firing Table VIII (a live-fire exercise fired annually for crew gunnery certification). The COFT test consisted of four exercises selected from the device's advanced training and evaluation matrix. The scores for these four test exercises, minus points subtracted for procedural errors (i.e., "crew cuts"), were then added and divided by 4 to provide a mean COFT test score for use in predicting Table VIII criterion performance.

Table VIII consisted of 10 live-fire engagements (6 day and 4 night) for which tank crews received a total score of from 0-1,000 points depending on their demonstrated gunnery proficiency. Each crew's goal on Table VIII was to fire at least the minimum qualification score of 700 on the first run down range. Although most crews failing to qualify on their first run were allowed to refire, only their first-run scores were used as the to-be-predicted measure of gunnery proficiency.

What We Found

The results of split-group cross-validation identified, as well as confirmed, the presence of a positive linear relation between COFT and Table VIII performance. To enable unit trainers to use this relation to predict which crews will fire a Table VIII qualification score ≥ 700 on their first run down range, an overall regression equation was computed for the scores of all 58 crews. Table VIII scores ranged from 268 to 961 ($\underline{M} = 668$, $\underline{SD} = 164$); COFT test scores ranged from 428 to 957 ($\underline{M} = 731$, $\underline{SD} = 132$), with a split-half reliability of $\underline{r} = .83$. The correlation ($\underline{r} = .77$) between COFT and Table VIII scores was significant with the former accounting for over half of the variance in the latter ($\underline{r}^2 = .59$, adjusted $\underline{r}^2 = .58$). Figure 1 shows the resulting scatterplot along with the significant ($\underline{F}(1, 56) = 79.59$) best fit regression line [$Y' = -26.74 + .95(X^1)$, $\underline{SE} = 106.22$].

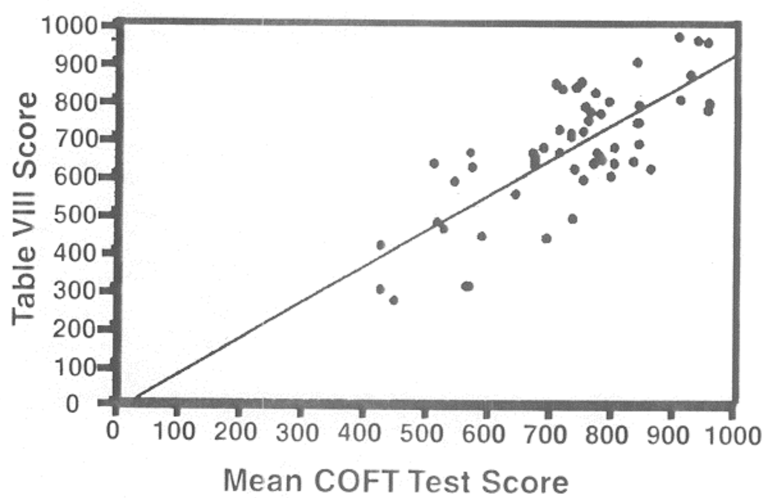


Figure 1. Relation between COFT and Table VIII scores.

Based on this regression equation, one can predict that tank crews with a COFT test score (X_1) of 765 will on the average fire a Table VIII score (Y') of 700. Assuming that the actual probability of firing this predicted Table VIII score will follow a normal distribution with $\underline{M} = 700$ and $\underline{SE}_{ind\ y} = 107.50$, we estimated the probability of an individual tank crew firing a Table VIII score ≥ 700 for a selected range of potential COFT test scores. Table 1 shows this range of COFT test scores (column 1) along with each score's predicted mean Table VIII value (column 2) and associated crew probability of scoring 700 or higher on Table VIII (column 3). Using this table, a unit trainer can predict that an individual tank crew with a COFT test score of 824, for instance, will on the average fire a Table VIII score of 756 and have a 70% chance of successful first-run qualification.

Mean COFT Test Score	Predicted Mean Table VIII Score	Probability of Firing ≥ 700 on Table VIII
620	562	10%
669	609	20%
706	644	30%
737	673	40%
765	700	50%
793	727	60%
824	756	70%
861	791	80%
910	838	90%

Table 1

COFT-Based Tool for Predicting a Tank Crew's Chances of First-Run Table VIII Qualification

From "Device-Based Prediction of Tank Gunnery Performance," by J. D. Hagman and M. D. Smith, *Military Psychology, 8(2)*, 59-68. Copyright 1996 by Lawrence Erlbaum Associates, Publishers. Reprinted with permission.

What This Means

Our findings indicate that a positive linear relation exists between simulated gunnery test performance on the COFT and live-fire Table VIII gunnery performance on the range, and this relation is both consistent (despite the relatively small sample upon which it was derived and validated) and of sufficient magnitude to support development of an easy-to-use COFT-based tool for predicting the probability of first-run tank crew qualification on Table VIII.

This prediction tool will help ARNG trainers make quick and accurate assessments of the readiness of individual tank crews for live-fire gunnery before their arrival on the range, thereby maximizing the payoff from each crew's live-fire experience while conserving costly main-gun tank ammunition in the process. It also provides researchers with an empirically derived set of performance standards for incorporation into past gunnery training strategies that until now have relied on speculation to estimate the level of device-based gunnery proficiency needed to ensure a crew's successful first-run Table VIII qualification.

Finally, this tool has enabled us to go a step further and develop an efficient, proficiency-based strategy for training tank gunnery with devices. This strategy requires only three drill weekends to complete and thereby ensures that ARNG armor unit trainers will achieve maximum benefit from the limited tank gunnery training time available.

More information on the prediction tool can be found in Hagman, J. D. & Smith, M. D. (1996). Device-Based Prediction of Tank Gunnery Performance. *Military Psychology, 8(2)*, 59-68. More information on the associated training strategy is available in *Armor 6*, 48-50 ("Research Pays off for the Guard: A device-based strategy for training tank gunnery").

Officer Personnel Inventory, Cost and Compensation Model

In 1991, ARI started work to develop an easy-to-use, well-documented tool to assist Army manpower policy and resource decision makers in projecting the long-term effects of manpower policies and resource decisions on the officer force. The result of this research effort is the Officer Personnel Inventory, Cost and Compensation (OPICC) Model.

OPICC provides the Army, for the first time, a single model in which inventory and compensation-retention modules are integrated. The prototype model focuses on Army Competitive Category officers and, despite its name, does not include a cost module. This tool integrates the results of existing research on the links between compensation and retention with a manpower projection capability to enhance the analyst's ability to capture the effects of a variety of personnel policies. Policy levers include military compensation, promotion policies, high tenure rules, early separation incentive programs, and retirement programs. OPICC improves the ease and accuracy of forecasting the effects of changes in personnel policy by eliminating the difficult task of working with different, and sometimes inconsistent, models and data sets.

A personnel inventory is the stock of soldiers at a particular point in time, differentiated by key characteristics such as grade or years of service. An inventory projection module predicts changes in the stock, over time, as individuals enter and leave the service under different Army personnel policy scenarios. Projected endstrength requirements are input and the inventory is then aged, using historical continuation rates, for up to 6 years, to reflect the effect of policy changes, with accessions making up the difference between endstrength requirements and existing inventory. In its current configuration, the inventory is dimensioned by years of service and grade. Branch-specific inventories are not currently included. Changes in military compensation affect continuation rates, which are the key input in assessing the year-to-year losses from the inventory. A compensation-retention module provides the quantitative link between compensation policy changes and continuation rates. Underlying this link is the Annualized Cost of Leaving (ACOL) model of reenlistment behavior, which has a sound theoretical foundation and a successful track record in similar policy applications. This module also allows the user to incorporate forecasts of external factors, such as unemployment rates and civilian pay growth, that also affect stay/leave decisions.

By establishing a link between military compensation and reenlistment rates, this module allows the analyst to address the following types of issues:

What are the inventory implications of proposed pay raise and allowance changes? If military pay is projected to decline relative to the civilian sector, for example, how much will voluntary losses increase? What are the likely effects of a proposed temporary separation incentive? What additional losses will be realized and how will this effect the composition of the officer force?

The OPICC model can be an invaluable predictive tool for U.S. Army manpower analysts in today's dynamic personnel environment. It is currently installed on PC-386/486 systems at ARI and at the Officer Division, Office of Deputy Chief of Staff for Personnel. A model description and user's guide are available.

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

Simulator Sickness in Virtual Environments

Immersive Virtual Environment (VE) technology, also known as virtual reality, is being touted as an important new medium for education and training. In 1992, the U.S. Army Research Institute Simulation Systems Research Unit initiated a research program to investigate the use of VE for training of dismounted soldiers. Through our own initial experience and anecdotal reports from other research sites, it quickly became painfully obvious that some users of VE systems experience unwanted side effects and aftereffects similar to symptoms of motion sickness. These effects are typically referred to as "simulator sickness." Common symptoms include nausea, dizziness, and headache or eyestrain. Simulator sickness is a potential problem with any simulator that portrays self-movement to the user, whether that movement is flying in a fixed or rotary wing aircraft, driving or riding in a vehicle, or moving on foot.

Simulator sickness is a concern for several reasons. Even if it does not produce severe symptoms, such as vomiting, it may degrade performance in the simulator. The discomfort may distract the student and interfere with learning. If trainees adopt behaviors that mitigate sickness during training, but will impair performance on the actual task (such as limiting head movements), simulator sickness may lead to negative transfer of training. Aftereffects involving the sense of balance or flashbacks could impair the user's ability to drive safely after leaving the simulator. Finally, the value of a simulator is reduced if simulator sickness forces a decrease in the frequency or duration of its use.

Factors Affecting Simulator Sickness

Simulator sickness is thought to result, at least in part, because simulated movement results in a conflict between human mechanical (vestibular) and visual systems for sensing movement. That is, the body detects that the relationship between what one feels and sees during "movement" in a simulator differs from the relationship between what one feels and sees during movement in the real world. Most simulators are limited in that they must be physically anchored in the real world, and can move at most only a few feet in any direction. Motion in any direction can be sustained for only a brief time. Motion in the simulator cannot be exactly the same as that in the actual vehicle. The simulator must therefore use a variety of "tricks," such as using tilt to substitute for sustained forward (horizontal) acceleration, and "subthreshold" return of the simulator to its neutral or resting position. Treisman proposed that a change or conflict in the relationships between the senses may be interpreted by the body as an indication that toxins (poison) have been ingested. Therefore, nausea reaching the stage of vomiting would have survival value by removing the toxins. According to this explanation, simulator sickness is an unfortunate result of the inappropriate activation of this nausea response.

We believe that this inconsistency between visual and motion cues forms part of the basis for simulator sickness. A variety of other individual factors, simulator characteristics, and task characteristics may affect the severity of the problem (see Table 1), but the root cause is inherent in the nature of the simulators themselves. McCauley and Sharkey proposed that simulator sickness is inevitable for a substantial proportion of users of flight and driver simulators. They stated that engineering fixes to simulator sickness are already in the region of diminishing returns. However, they noted that although even excellent engineering may not prevent sickness, poor engineering or calibration will contribute to simulator sickness.

Individual Characteristics	Simulator Characteristics	Task Characteristics
Age	Binocular Viewing	Acceleration Rates
Concentration Level	Calibration	Degree of Control
Ethnicity	Display Characteristics	Duration
Experience with Task	Motion Platform	Global Visual Flow
Experience with Simulator	Position Tracking Error	Head Movements
Flicker Fusion Threshold	Scene Content	Method of Movement
Gender	Transport Delay	Self-movement Speed
Illness	Viewing Region	Seated vs. Standing
Mental Rotation Ability		Vection
Perceptual Style		
Postual Ability Calibration		

Table 1.
Some Factors which Influence Simulator Sickness (from Kolasinski).

In addition to these inconsistencies in motion perception, the VE displays, such as the Head-Mounted Displays (HMD) in Figure 1, may create visual system problems. In normal viewing, our eyes change accommodation (focus) and convergence (coordinated inward and outward movement) to view objects at different distances. Simulator visual displays place all objects at the same distance from the eyes, eliminating the changes in focal length usually encountered in real-world vision tasks. Discrepancies between accommodation and convergence cues may contribute further to eye strain problems in using HMDs.

Another possible contributor to simulator sickness involves the time lag between user-initiated head movement and the representation of that movement by the VE system (transport delay). Most HMDs with head tracking produce a slight but noticeable delay between the viewer's head movement and the visual display changes which match

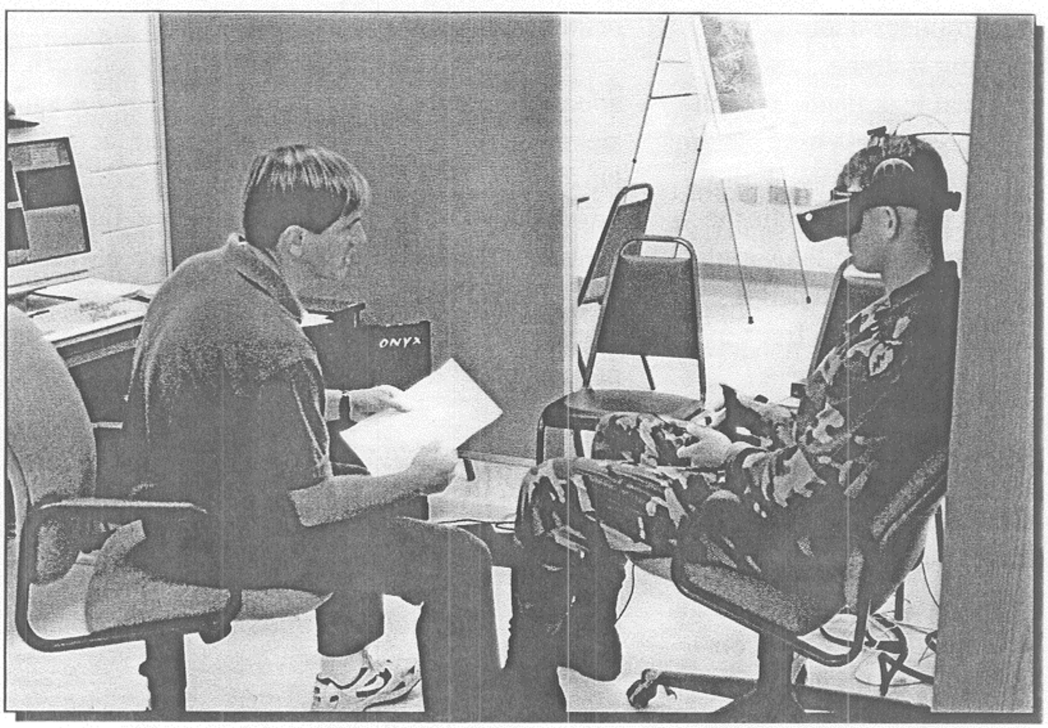


Figure 1.

A soldier wearing an immersive HMD.

that head movement. The effect may be even worse if the lag is not constant, but varies as the complexity of the visual display changes from moment to moment. Display lag may be a cause of dizziness that is experienced with some HMDs.

Measuring Simulator Sickness

Questionnaires, or symptom checklists, are the usual means of measuring simulator sickness. The Simulator Sickness Questionnaire (SSQ), described by Kennedy et al., consists of 16 symptoms that are rated by the subject on a 4-point scale (0=absent, 1=slight, 2=moderate, 3=severe). These ratings form the basis for three subscale scores - Nausea, Oculomotor Discomfort, and Disorientation - as well as an overall Total Severity score. The symptoms making up the three subscales are as follows: Nausea - general discomfort, increased salivation, sweating, nausea, difficulty concentrating, stomach awareness, and burping; Oculomotor - general discomfort, fatigue, headache, eyestrain, difficulty focusing, difficulty concentrating, and blurred vision; and Disorientation - difficulty focusing, nausea, fullness of head, blurred vision, dizzy (eyes open), dizzy (eyes closed), and vertigo. The Total Severity score is based on a weighted sum of symptom scores. The Total Severity score reflects the overall extent of symptom severity and is therefore the best index of whether or not a sickness problem exists, while the SSQ subscale scores can provide diagnostic information as to the specific nature of the resulting sickness. Unfortunately, there are no benchmarks or standards to indicate those scores above which training might be affected, or aftereffects might occur.

In addition to the symptoms identified by the SSQ, loss of sense of balance, also called postural disequilibrium or ataxia, is another potential aftereffect of simulator exposure. Although sophisticated devices are being developed to measure ataxia, current simulator sickness research often uses something similar to the "road sobriety test" administered by traffic officers.

Simulator Sickness in VE Experiments

We measured the incidence and severity of VE immersion aftereffects experienced by participants in ten experiments conducted to examine VE training applications. The participants in these experiments were usually seated or standing in place, and using an HMD. The mean SSQ Total Severity score for each experiment is presented in Figure 2. While the

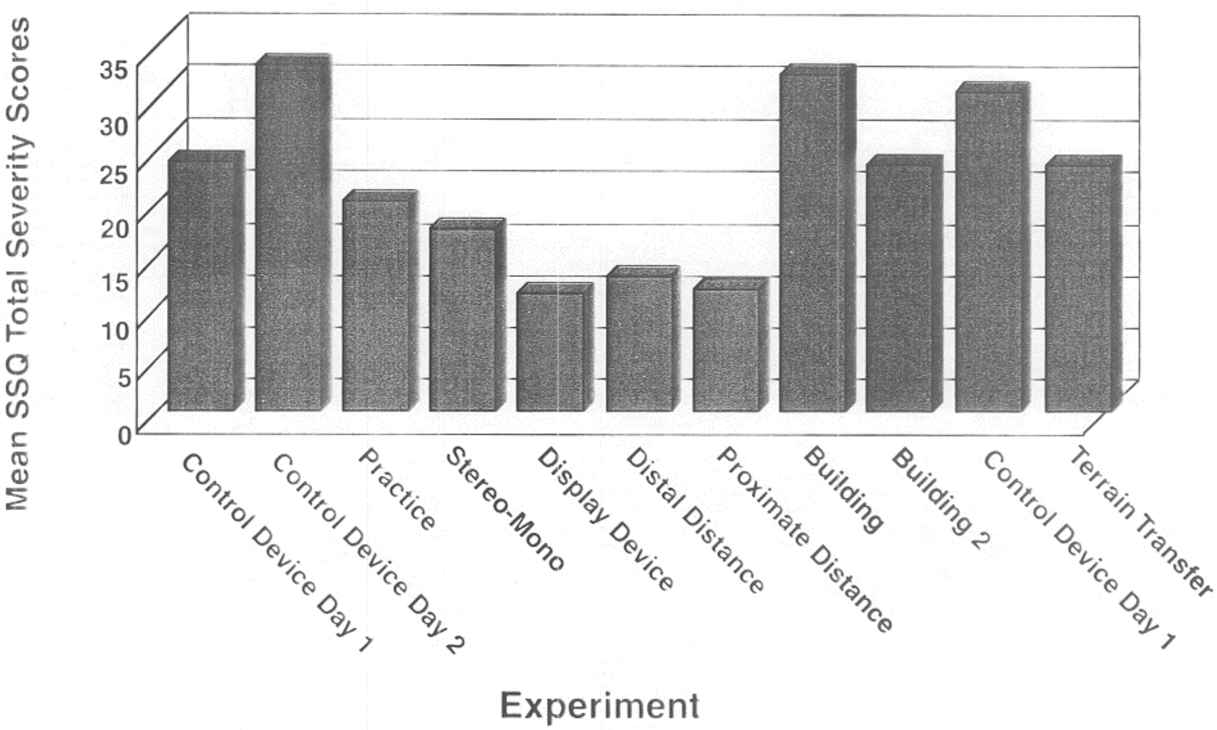


Figure 2. Mean Simulator Sickness Questionnaire Total Severity scores across experiments.

experiments differed in a variety of characteristics (different image generator, display and controlde-vices) these data suggest that the *longer sessions in VE and frequent simulated motion* are characteristic of research conditions that have caused the most discomfort. For example, in the distance estimation experiments, participants spent approximately 12 minutes in VE, and experienced no simulated self motion. They had the lowest Total Severity Scores we observed. In the first building experiment, participants were in the VE for an average of 80 minutes, and were nearly always in self motion. They had the next-highest Total Severity scores. The same image generator and display device were used in both experiments.

The percentage of participants who have withdrawn from our experiments because of simulator sickness has ranged from 0% to 17%. However, those participants who requested to be excused from the experimental session because of simulator sickness usually did so within the first 10 minutes of immersion.

We have not yet been able to establish that simulator sickness causes poorer performance or learning. While participants who experience more severe symptoms generally perform worse, the nature of our tasks is such that participants who are initially poor performers spend more time in the VE. Thus the poor performance may indirectly cause the symptoms, rather than vice versa.

Conclusions and Future Research Directions

While simulator sickness can be a problem for VE use, it does not seem to be an insurmountable one. As long as VE use is limited in duration and frequency, reasonable precautions, including careful monitoring of participants and initial short training sessions having low nauseogenic characteristics, should preclude serious disturbances. Frequent or extended use, however, will require additional research to develop ways to prevent, mitigate, or hasten the recovery from simulator sickness, while providing sufficient realism for effective training and transfer. While the SSQ has proved to be a valuable instrument for comparing relative levels of simulator sickness across experimental conditions and different VE systems, it lacks standards which indicate when simulator sickness affects the performance, training, and well-being of VE system users.

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

The Leader AZIMUTH Check:
A Leader Self-Development Tool

"Self-Development is an important part of every officer's leader development. It applies equally to Active and RC officers. Self-development starts with awareness of strengths and weaknesses, and developmental needs......" (DA PAM 350-58, pg.40)

In order to provide Army officers with a tool for obtaining feedback from multiple sources for leader self-development, the Fort Leavenworth Research Unit of ARI has undertaken the development of a 360 degree assessment instrument, the Leader AZIMUTH Check (AZIMUTH). The value of AZIMUTH stems from two factors. First, AZIMUTH provides the context within which individuals can take a serious look at their own attitudes and behaviors. Second, they get candid feedback from other individuals who have had the opportunity to see them in action.

AZIMUTH can be used in a variety of ways. In some cases a full 360 degree assessment will provide selected leaders with feedback from subordinates, superiors, and peers as well as from their self ratings. In other cases, such as in a school setting, administration of AZIMUTH is restricted to self and peer ratings only.

As the above excerpt from DA PAM 350-58, Leader Development for America's Army - The Enduring Legacy, points out, the starting place for any self-development plan must be an accurate assessment of relevant personal strengths and weaknesses. However, few individuals are able to assess themselves accurately. Thus, the idea for a 360 degree assessment methodology has grown in popularity in recent years.

The 360 degree assessment methodology compares self-ratings with the ratings of knowledgable others. This allows an individual to compare self-ratings on relevant competencies to the ratings made of him or her by peers, subordinates, and superiors. The information available is substantially enriched as each of the "other" groups has the opportunity to provide feedback from their unique perspectives. This structured feedback becomes increasingly important as leaders move up in an organization as, typically, feedback opportunities diminish as one moves into higher levels.

A primary application of the 360 degree assessment and feedback has been to enhance self-awareness of strengths and weaknesses so as to guide self-development efforts. Such assessment activities are usually based on two key assumptions: (1) that awareness of any discrepancy between how we see ourselves and the way others see us enhances our self-awareness, and (2) that enhanced self-awareness is a key to maximum performance as a leader.

Evolutionary Development

The Leader AZIMUTH Check is derived from the Strategic Leader Development Inventory (SLDI) which was jointly developed by ARI, the Army War College, and the Industrial College of the Armed Forces in a long term project directed by Dr. T. Owen Jacobs, formerly at ARI.

Jacobs was particularly concerned with the demands made by positions of strategic leadership and with the skills and knowledge required of individuals who hold those senior leadership positions. He and his colleagues developed the SLDI, a 360 degree assessment instrument, to help individuals assess their abilities and needs for self-development.

In 1994, the SLDI was integrated into the curriculum of the Combined Arms Services Staff School (CAS3) at Ft. Leavenworth, Kansas. CAS3 is a nine week course for Army captains which covers basic decision making, briefing, and general staff skills. In this setting, only the self and peer forms of the SLDI were used. Data from several of the 1994 CAS3 classes were factor analyzed to determine if the original factor structure would hold for this sample of approximately 3000 junior officers. It did not - the factor analysis of Captain data yielded a factor structure which contained fewer factors than the factor structure obtained with the senior officers.

Starting with the factor structure obtained with the CAS3 data as the point of departure, the individual items were examined for their contribution to the factor on which they loaded. This examination targeted several weak items for elimination. In addition to eliminating weak items, new items were added to strengthen the factor structure. The added items were ones developed from and based upon the Army leadership competencies contained in FM 22-100. The instrument which was born from these modifications became known as the Leader AZIMUTH Check and is currently being tested with several populations of Army officers.

The items which make up AZIMUTH represent twelve "elements" of leadership. Table 1 above shows the doctrinal leadership competencies which are associated wtih each of the AZIMUTH elements.

Table 1
Comparison of the AZIMUTH Elements and Doctrinal Leadership Competencies

AZIMUTH Element	Doctrinal Leadership Competencies
Communication/Influence	Communication
Political Skills	Communication
Problem Solving Skills	Decision Making
Planning/Organizational Skills	Planning
Ethics	Professional Ethics
Team Focused Supervision	Supervision
Mission Focused Supervision	Supervision
Compulsive Behavior	Supervision
Self-Centerdness	Supervision
Social Maturity	Supervision
Interpersonal Supervision	Teaching and Counseling
Tactical and Technical Knowledge	Tactical and Technical Proficiency

Reliability of AZIMUTH

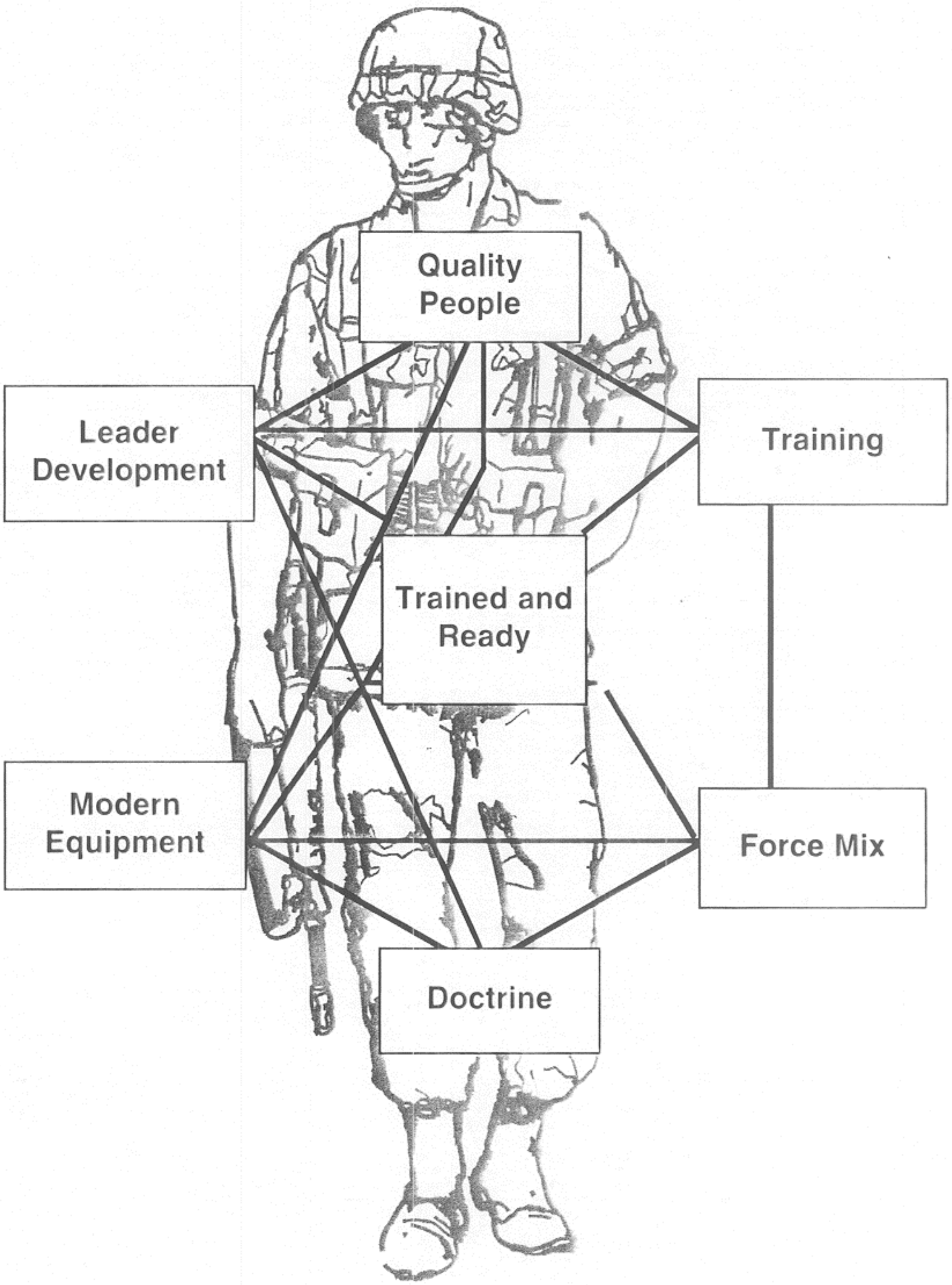
AZIMUTH has currently been administered to several classes at CAS3 (self and peer only), to selected students (majors) at the Command and General Staff Officer Course, and to military and civilian leaders at a Training and Doctrine Command installation.

To date, only limited reliability analyses have been conducted. AZIMUTH is still considered to be in the developmental stage. Once a stable factor structure is achieved, studies will be conducted to obtain more complete measures of reliability.

Future Directions

Future efforts will be directed towards further testing to achieve a stable factor structure with Army captains and majors, more complete examination of the validity and reliability of AZIMUTH, and the development of training strategies for improvement of targeted areas.

Research questions which still remain to be investigated include the issue of whether AZIMUTH is a "one size fits all" instrument or will require modification for different leadership levels. Also, interesting questions remain to be answered in regard to the relationship between individual differences in AZIMUTH profiles and future performance outcomes. Plans are in progress for the establishment of a longitudinal data base to provide a means of tracking individual career progress, and the relationship of AZIMUTH and other selected measures to career outcomes.



Building the Ultimate Smart Weapon: The American Soldier

Shared Mental Models, Collective Problem Solving, and Collective Training

The emergence of synthetic training environments, such as Distributive Interactive Simulation (DIS) (examples are Simulated Networked Simulators (SIMNET) and Close Combat Tactical Trainers (CCTT)), allows the Army to train teams, crews, and platoons to be more adaptable and flexible than has ever been possible before. Because DIS simulates the dynamic nature of the modern battlefield, it provides commanders with the ability to design realistic exercises. It offers greater control over terrain variables (e.g., desert vs. forest) and other operational conditions (e.g., nature and type of enemy) that combat units will encounter in future battlefields. Through its ability to collect unit performance data and replay exercises, it also enables commanders to improve crew/team performance by providing corrective feedback during After Action Reviews (AARs). And this ability to train in a real-time virtual combat environment, with greater precision and control than ever before, can be applied to units sized from the platoon to the battalion.

However, little is known about how to employ such resources to train combat units to solve novel problems collectively. Older reviews of team performance research provide few if any prescriptions for enhancing team training on-line. In 1994, the Advanced Training Methods Research Unit began such a program of research to investigate instructional methods and strategies for the training of collective skills of teams, platoons, and companies.

Our plan was to start in the laboratory and to follow with an evaluation of applied findings in the field. Our first step was to formulate a conceptual framework of collective behavior and effectiveness. We identified the training variables that improve the acquisition of collective skills and pinpointed those instructional features of the CCTT which facilitate skill acquisition. We also examined the utility of various tactical knowledge representation schemes within CCTT exercises. Among specific issues we researched (pacing, use of massed vs. spaced practice, type of feedback, etc.) was the use of shared mental models in training. Experiments were conducted to examine all these factors, but our focus here is on studies of the effect of one training strategy upon collective task performance: encouraging the use of shared mental models.

Research on the Use of Shared Mental Models

Mental models are knowledge structures that an individual creates as a task is learned and uses as the task is performed. Well-developed mental models are thought to help individuals process and classify information more efficiently and form more accurate expectations and predictions of task events. The sharing of such models among team members enables them to better anticipate each other's actions and reduce the amount of processing and communication required for performance. Because high level team performance requires this anticipation and coordination of individual actions, several researchers in the team training community have argued that effective team performance depends upon the emergence of a shared mental model, a common understanding among team members of expected collective behavior. Shared mental models can be defined as "knowledge structures held by members of a team that enable them to form accurate explanations and expectations for the task and, in turn, to coordinate their actions and adapt their behavior to the demands of the task and to other team members".[1] In particular, since shared mental models allow team members to anticipate and predict the resources and informa-

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1 Cannon-Bowers, J.A., Salas, E. and Converse, S.A. (1993). Shared mental models in expert team decision making. In N.J. Casellan, Jr. (Ed.), Current issues in individual and group decision making. Hillsdale, NJ: Erlbaum.

tional requirements of their teammates in the absence of explicit strategizing, they should help teams adapt and coordinate under adverse and novel conditions.

Several researchers have suggested different ways to encourage the development of shared mental models. It has been suggested that cross training might foster a common understanding of the roles and responsibilities of team members; simulations targeted at team training might be an effective approach to developing shared mental models. Despite considerable conceptual development and calls for empirical research, there have been few if any studies that have investigated shared mental models and their proposed effect on team performance. One factor impeding empirical research in this area has been the lack of a low cost combat environment in which to conduct the research. The series of experiments reported here used undergraduate psychology students as subjects and utilized a computer simulation developed specifically for this research program, Team Wargame Interaction Simulation Training (TWIST). All experiments were conducted at the ARI/GMU Team Training Laboratory over the past three years. The purpose of this research was to identify factors that influence the development of shared mental models and to examine the effects of such models on the coordination and performance of teams.

TWIST was designed to emulate many of the training features of the DIS environment. For example, TWIST has the capability to visualize and simulate the dynamic nature of the battlefield, design exercises, manipulate terrain variables (e.g., desert vs. forest), and other operational conditions (e.g., nature and type of enemy). Through its ability to replay exercises and collect unit performance data, TWIST is capable of providing corrective feedback. TWIST has the capability to generate combat offensive and defensive mission scenarios and to manipulate the capabilities of each tank. (For example, in one scenario one tank did not have firing capability but could build protective barriers and lay mines; other tanks had no building capacity but could engage enemy tanks in combat. One of these latter tanks could also lay mines, while the other had the unique capacity to gain multiple views of the battlefield and to adjust its gun sight.) In addition, through its data collection component, TWIST can record individual and team activities as they occur. Team activities, such as communications and maneuvers, are recorded using audio and videotapes; individual data are recorded by a computer program that counts key strokes, shells fired, and direct hits on the enemy. TWIST thus has the capability to provide a continuous record of team task performance. Coordinated performance is assessed by examining team performance on tasks, such as building protective barriers, that require all tanks to work together and coordinate their activities.

Measurement of Shared Mental Models

Another major roadblock to research on mental models and shared mental models has been the lack of reliable and valid measures. This is a particularly difficult problem, because the measurement of shared mental models involves the assessment of knowledge structures in individuals, as well as the extent of agreement across individuals in a team. We employed the technique of concept maps to measure team mental models. Concept maps can be defined as representations of meaning frameworks specific to a domain of knowledge, for a given context. Two or more concepts can be linked together with words to form propositions, and propositions are seen as the units of psychological meaning. The meaning of any concept for a person is represented by all of the propositions that person could construct that include that concept. Concept maps can be organized to form hierarchical representations of knowledge in any conceptual domain. Such concept maps are particularly useful as measures of shared mental maps because they (a) can be easily applied to individuals, (b) are objective and easily scored, and (c) identify both the amount of knowledge retained by individual members and the relationships among concepts.

In several studies, we formed students into teams of three. Each team member "operated" a single tank which had one capability, either to fire, to build protective devices, or to play a scout role in engaging the enemy. After extended practice, we provided each team member with twelve team scenarios and asked the student to identify, in sequence, the actions which a given scenario required of each team member. This was done by giving everyone a tree-structured map with empty choice point nodes. Each team member was given cards naming specific actions. Individually, the team members filled in the tree by placing the card denoting a required action onto an empty node in the map. The quality of one person's tree-map was judged by the percentage of all required team-member actions accurately identified. A computer program was used to assess the number of required actions accurately identified by one, two, or three team members. This amount of overlap among team members' maps was taken as an estimate of the amount of overlap among their mental models. The results clearly showed a correlation between the degree to which the mental model for the collective combat task was shared among the three team-members and superior team performance.

Our major findings are: (1) A training strategy consisting of specific instructions and distributed knowledge of team member roles produces shared mental models. (2) The use of shared mental models enhances team performance and problem solving and facilitates the acquisition of collective skills. A particularly interesting result is that shared knowledge of team roles is critical for performance on collective tasks but not necessary for individual performance.

Conclusions and Future Research

This research effort has yielded three important contributions to unit and collective training for the Army: (1) The formulation of a conceptual framework for guiding the development of further training methods using shared mental models in DIS environments; (2) The derivation of compatible unit and collective performance measures; and (3) The development of TWIST, a low cost, high fidelity simulation that emulates many of the training features of expensive DIS systems. The results described here have been obtained from laboratory experiments with college students. Experiments are now being conducted at two ARI field units: The Armed Forces Research Unit at Fort Knox and the Rotary Wing Aviation Research Unit at Fort Rucker. The objectives of this new research are to extend the shared mental model research to a training environment with soldiers and to assess the efficacy and utility of the laboratory-developed unit performance instruments in the field.

Scientific and Technical Information Office Highlights

Full-Text Search Now Available on ARI Web Site

The ARI DARS (Document Archival and Retrieval System) is a stand-alone, full-text archiving, search, and retrieval system designed exclusively for ARI's own technical documents. The DARS database contains over 300,000 text and image pages. It is physically located at ARI HQ in Alexandria, VA and consists of a SPARC Ultra server running Excalibur Retrieval software. DARS contains full-text files, both image and OCR-based, of all unclassified, unlimited ARI technical documents. Current documents are periodically scanned in to keep the system up to date. Recent enhancements have enabled the ARI Library staff to make DARS available through our WWW home page.

The ARI DARS differs from the DTIC (Defense Technical Information Center) on-line data base, which also contains all ARI technical documents. The DTIC data base may also be searched on the WWW, or from any participating library, but that search only applies to information from the DD Form 298 (Report Documentation Page) which is filed with each document. Any document citations retrieved during the course of a DTIC search session must then be ordered from DTIC. DTIC operates a fee-based ordering service providing the user with documents in either microfiche or hard copy.

The ARI DARS, on the other hand, offers users the ability to search the database, which contains the full text of all ARI technical documents. The user can then display a tiff file of each page of the document, which is available for downloading or printing. (DARS is most viewable when the 800 X 600 resolution is used.) We hope eventually to offer the entire textual document for immediate downloading to the user's workstation in electronic file format. The file would then be available for printing either locally or on a network printer. This capability will be announced on the web site. (Note that ARI does not offer mediated search, retrieval, or reprinting services above and beyond maintaining the DARS web site.)

The ARI WWW site address is http://www.ari.fed.us. The DARS can be accessed directly using http://dars.ari.fed.us.

ARI-Consortium Partnership Highlighted

An article in a recent issue of Army RD&A magazine (Jan-Feb 1997) describes a long-standing partnership between ARI and the Consortium of Universities of the Washington Metropolitan Area. The Consortium Research Fellows Program (CRFP), which began in 1981 and is funded by ARI and managed by the Consortium, links the academic behavioral and social science community with ARI's program of research into issues of relevance to the Army. Since its inception, the CRFP has placed 280 Fellows at ARI HQ in Alexandria, VA and at 10 of its field units. Fellows have come from 23 universities in 13 states and the District of Columbia. The majority have been graduate students in psychology; others have come from the fields of sociology, computer science, economics, education, engineering, information systems, linguistics, mathematics, and operations research. Currently, 65 graduate students are involved in the program, representing 19 universities nationwide. Many students have been able to complete dissertation research in conjunction with their assignments at ARI. This sharing of information, ideas and expertise strengthens both education and research in the behavioral and social sciences and contributes materially to ARI's mission.

Recent Books

Recent ARI Book Summarizes Executive Leadership Research

Executive leadership has been a long-standing concern of the U.S. Army. However, prior to 1980, much of the military research focused on generic dimensions of leadership or were specifically concerned with leadership at lower grades. In the early

1980s the Army recognized a need for greater and more focused research on the nature of leadership at he brigade command level and higher. This interest parallels the increasing focus on top organizational leadership in the nonmilitary literature. As a consequence of this increased attention and interest, ARI started a program of research that focused on the nature and determinants of effective military executive leadership. The mission of this research was to develop and test concept materials for doctrine development at the executive level, formulate an executive development system, and formulate and test methodology for restructuring Army organizations to achieve gains in productivity, effectiveness, and esprit.

This mission has resulted in an extensive research program that has focused on four themes. The first was the nature of executive-level work within the Army, and particularly how work and performance requirements change across organizational levels. A second theme was the identification of individual capacities, knowledge, skills, abilities, and other qualities associated with the successful completion of executive work requirements; if the nature of leader ship performance requirements changes at different executive or organizational levels, then the requisite individual qualities should also change. A third theme was the development of measurement technologies to assess individual characteristics identified as necessary for effective executive leadership. The fourth, and perhaps most important, theme was the formulation of both targeted and system-wide developmental interventions and technologies to facilitate the acquisition of requisite executive leadership skills.

After over 10 years of research centered around these major themes, there was a need to evaluate the advances and contributions made to an understanding of executive leadership and its development. Accordingly, a new ARI book, "Models and Theories of Executive Leadership: A Conceptual/Empirical Review and Integration" by Stephen J. Zaccaro, reviews military and nonmilitary research on executive leadership. Its objectives are (a) to describe and critically analyze both leading conceptual models of, and empirical research on, executive-level leadership according to several a priori criteria; (b) to synthesize military and nonmilitary research to determine what is known about executive leadership; and finally (c) to identify some necessary future directions for research in this area.

The book examines several leading conceptual models that focus on the nature and requisite personal characteristics of executive leadership. A survey of leadership research from different disciplines (e.g., psychology, public administration, strategic management) suggested four major conceptual perspectives of organizational leadership in the extant literature: (1) conceptual complexity, (2) behavioral complexity, (3) strategic decisionmaking, and (3) visionary or inspirational leadership. Each approach, with its corresponding empirical research base, is the subject of different chapters. Each conceptual model was reviewed according to several criteria, some from previous theory and some developed for this book to reflect particular interests and concerns of the U.S. Army. The empirical research bearing on hypotheses and postulates developed from each conceptual framework was also evaluated to determine the degree of validation for these models in the extant literature.

The book concludes with several recommendations for future military-based research on executive leadership. As a review of research and an assessment of the state of the art in this field, this book should prove an invaluable source document for executive leadership researchers. ***It is available from DTIC*** as #ADA320259.

Reserve Component Soldiers as Peacekeepers

Research and development to increase the readiness and deployability of Reserve Component (RC) soldiers has been a long-standing program area of ARI. There is currently increased interest in utilizing RC forces to support the increased operational tempo of U.S. forces as the size of Active Component (AC) forces and defense budgets has declined. One of the new strategies being developed is to use RC soldiers to augment or replace AC soldiers. ARI assisted the Chief of Staff of the Army to test this concept using one of America's oldest peacekeeping commitments: the Egyptian-Israeli border in the Sinai. The Chief of Staff's concept was modeled after the World War I "Rainbow Division" in which National Guard soldiers from across the country were formed into a single division under AC leadership.

A recent ARI-published book, "Reserve Component Soldiers as Peacekeepers," Edited by Dr. Ruth Phelps and Dr. Beatrice Farr, provides the results of an intensive two-year assessment of a mixed AC/RC battalion used to fulfill the U.S. peacekeeping commitment in the Sinai. In addition to its expertise in the RC, ARI drew on its institutional capabilities in recruiting and selection, training, economic/life course impacts, family support, leadership, and cohesion. Our experience in personnel performance and training research with previous and ongoing peace missions provided an invaluable context for understanding the degree to which our findings will validly apply to other missions.

Our findings support the use of RC volunteers for the peacekeeping mission in the Sinai. Qualified RC soldiers volunteered, the unit successfully performed the mission, the families throughout the country were supported, and the RC unit from which most of the volunteers were drawn experienced only temporary decreases in readiness but a consistent increase in morale. Within the respective chapters on these topics, the generalizability of these findings to other missions is discussed.

Our purpose for organizing this research into a book was to make it accessible to military and academic audiences. We hope the military will continue to use these findings to inform decisions and policies about new roles and missions for the RC, and that academia will benefit from the theoretical interpretation as well as theoretical expansion.

This book is available from DTIC as #AD A321 857.

Recent Reports

The ARI "Products Book"

A new type of ARI document was made available this last fall — "The ARI 'Products Book' — Recent Achievements in Soldier-Oriented Research and Development". This glossy, full-color document focuses on recent products of ARI's applied research (6.2) and advanced technology development (6.3) efforts, and also includes some products from ARI's research-based studies and analysis (6.6) program. In addition to summaries of 45 different products, it provides a subject index and a point of contact for each product. ***The Products Book is available from the ARI Scientific and Technical Information Office (STINFO)***, or via E-mail to witter@ari.fed.us.

The Army's Occupational Analysis Program

ARI's Occupational Analysis Office (OAO) recently published a progress report detailing their program and providing examples of occupational analysis (OA) projects. This report discusses the role of OA in the Army, job design and analysis in Army force development and training, who our customers are, tools of the OA program, and future directions. ***This report is available from the ARI OAO*** (DSN 767-0322), or via E-mail from badey@ari.fed.us.

Report Summarizes 13 Years of Selection and Classification Research

A recent ARI Special Report (S-28), "Soldier Selection: Past, Present, and Future" by Lola M. Zook, is intended for readers who have an interest in military personnel selection and assignment. It describes a long-term research program — Project A (began 1982) and Building the Career Force (ended 1995) — to evaluate and enhance the Army's process of selecting qualified applicants for enlistment and assigning them to the most appropriate jobs. A model of the elements of enlisted job performance is presented. Then, findings on the powers and limits of selection and assignment tests, both operational and experimental, are reported. This research shows that it is hard to improve on the power of the operational test battery (the Armed Services Vocational Aptitude Battery [ASVAB]) to predict individuals' overall skilled technical performance in the Army, but that experimental tests of temperament add greatly to predicting motivational outcomes such as effort, discipline, and completion of enlistment. Applicants' scores on ASVAB also relate strongly to their performance in combat and in the second tour. An extensive reference list and glossary of terms in selection and assignment are provided. Appendices depict the enlisted career life cycle and a short history of military selection. *This report is available from DTIC* as # AD A321 806.

Naturalistic Decision Making

Because traditional decision research programs have not been very successful in addressing Army operational needs, ARI undertook, about 10 years ago, the sponsorship of an alternative line of investigation into what is known as naturalistic decision making (NDM). During the 10 years in which it has been emerging as a line of inquiry, NDM research has contributed to a number of changes in decision research, signifying a major shift in the study of decision making. A recent ARI special report, "Making Decisions in Natural Environments" by Gary Klein, is written from the perspective of a researcher who has been active in developing models and methods in this new approach. It surveys the field of NDM and shows its potential for supporting the needs of the U.S. Army, including the use of information technologies, downsizing, and changes in mission.

The goal of NDM is to examine the way people make decisions under operational conditions. The focus is on field studies rather than on laboratory settings where naive subjects perform artificial tasks. NDM research is about how people use experience to make decisions under time pressure, shifting conditions, unclear goals, degraded information, and team interactions. Currently, NDM research is being conducted in domains such as aviation, battle command, health care, and process control, looking at both individuals and teams. It is sponsored by all branches of the military along with other federal agencies and commercial sources.

The NDM framework appears to have great potential for application to Army needs. The framework addresses the specific decision requirements (critical and difficult judgments and decisions) within a domain and determines why these are difficult and what cues and strategies are needed to handle the difficulties. This decision-centered approach has been used to design better training programs and better human-system interfaces. The NDM framework also emphasizes training for team decision making, and it has some implications for better mission rehearsal methods.

This report will soon be available from DTIC.